ON THE SPINNING ORGANS AND ARCHITECTURE OF EVAGRUS, A THERAPHOSID ARANEAD.[1]

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The most important work on the spinning glands of spiders is that of Apstein (1892), who distinguished the five following kinds:

1. *Aciniform Glands.* — Oval-shaped glands with long duct; gland consists of tunica propria and epithelium, which stains evenly in all parts, duct of which bears no epithelium and ends on a spool with long spinning hair.

2. *Piriform Glands.* — Pear-shaped glands consisting of tunica propria and epithelium, the lower portion of which stains deeper than upper portion; the duct bears a thick tunica intima and ends on a short thick spool, with thick spinning hair.

3. *Ampullaceous Glands.* — Sac-like glands consisting of tunica propria and epithelium, of which the upper portion is cylindrical, then has a sac-like swelling from which the duct consisting of tunica propria, epithelium and tunica intima forms a double loop, the three branches of which are formed in a tunica propria, and ends on a large truncate spinning spool.

4. *Tubuliform Glands.* — Cylindrical glands consisting of tunica propria and epithelium, duct consists of tunica propria, epithelium and tunica intima and ends on a large spool.

5. *Aggregate Glands.* — Aboraceous glands of tunica propria and epithelium, with wide ramifying lumen of which the duct, consisting of tunica propria, epithelium and tunica intima bears protuberances and ends on a large spool with long pointed spinning hair.

Apstein gives only a short description of one of the Theraphosids, *Lasidora Erichsonii*, of the family Aviculariidæ. He found in these only piriform glands, of which the spinning hairs were ringed or annulated.

The only subsequent work is that of Warburton (1890) on Argiopids; McCook (1890) on Epeirids; Borgert's (1890) general

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review; and descriptions of the external anatomy of the spinnerets given by Simon (1892).

Therefore the spinning glands of Theraphosids are practically unknown and the present contribution is to present an account of a member of that group, and was done under the direction of Prof. Thos. H. Montgomery, Jr.

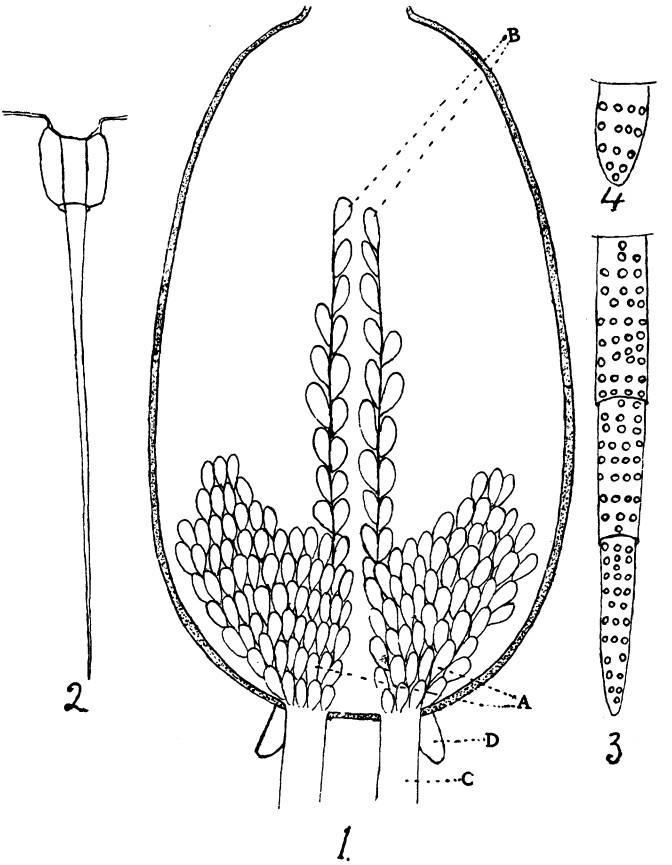
Simon (1892) divides the spiders into *Araneæ Theraphosæ* and *Araneæ Veræ*, the former including all spiders with chelicera directed forward, and comprising the families Liphistiidæ, Avicularidæ and Atypidæ. The Liphistiidæ are unique among all spiders in having four pairs of spinnerets; the Avicularidæ have only two pairs (except *Hexathele* which has three), while the Atypidæ as also most of the families of *Araneæ Veræ*, possess three pairs.

There has been a discussion as to the homologies of the two pairs of spinnerets of the Avicularidæ with the three and four pairs of the Atypidæ and Liphistiidæ. Jaworowski (1895) has shown that in Lycosids the embryonic extremities of the fourth and fifth segments of the abdomen give rise to the spinnerets in the following manner: each extremity of the fourth segment consists of two parts, endopodite and exopodite, of which the exopodites give rise to the anterior pair of spinnerets, while the endopodite of one side fuses with its fellow of the opposite side to form the colulus or its homologue the cribellum. As for the extremities of the fifth segment, the endopodites give rise to the median pair of spinnerets and the exopodites give rise to the posterior pair.

Now, it is possible, as Jaworowski believed, that of the four pairs of spinnerets of the Liphistids, the most anterior pair is homologous with the colulus and cribellum of the *Araneæ Veræ*. But just what are the homologies of the three pairs of spinnerets of the latter to the two pairs of the Avicularidæ cannot yet be decided, as the embryology of no Theraphosid has been worked out, although Simon considers the two pairs of the Avicularidæ to correspond to the anterior and median spinnerets of other spiders, while Jaworowski would hold them as homologous with the anterior and posterior spinnerets of other spiders. Accordingly in calling the spinnerets of *Evagrus* "anterior" and "posterior" respectively, following the general usage, I do not mean to prejudice the question of their homologies.

In my work on *Evagrus*, fresh material was used and the best plan was found to be to dissect them in water or very weak alcohol. The abdomen was opened from the dorsal surface, and the liver, rectum and ovaries removed, leaving the translucent spinning glands exposed to view.

There are only two pairs of glands in both males and females, one pair for each pair of spinnerets, as shown in Fig. 1. The



large pair *a*, which consists of a cluster of about 100 small piriform glands has its outlet through the larger or posterior spinnerets *c*, and the long gland *b* consisting of 12–16 piriform glands, bilaterally arranged, belongs to the smaller or anterior pair of

spinnerets *d*. The ducts of these glands end on the same kind of spools, the spools having three parts, Fig. 2, a short flexible part, then a short heavy chitinous basal piece which terminates in a long spinning hair. According to Apstein's classification, these glands would be piriform glands, being pear-shaped and ending on a spool with short thick base, but differing in having a long spinning hair.

Of the two pair of spinnerets, the posterior consists of three joints, while the anterior has only one short piece. These spinnerets bear spinning spools only on the ventral surface. On the posterior pair, Fig. 3, the spinning spools seem to be about equally distributed over the whole ventral surface, thereby differing from most spiders. On the anterior pair, Fig. 4, the number of spools seem to correspond with the number of glands which empty into it.

The females of two other genera of this same family were dissected, *Stichoplastus* (?) and *Myrmeciophila*, and these were found to agree in general with *Evagrus* in having only two pairs of spinning glands, composed of piriform glands.

In *Stichoplastus*, the glands of the posterior spinneret were similar in position and number to those of *Evagrus* but were a little larger and curved in shape. As to the glands of the anterior spinneret, they were about twelve in number, differing from *Evagrus* in that they varied in size, four being larger and far apart, and eight posterior, small and closer together. In *Myrmeciophila*, the glands were exactly similar to *Evagrus* except in number, *Myrmeciophila* possessing about 25 or 30 glands to the anterior and 150 to 200 to posterior pair of spinnerets.

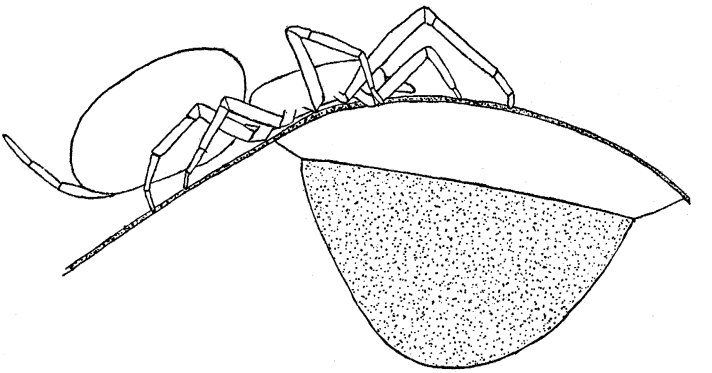
The primitiveness of these Theraphosids is shown in the limb-like elongation of the spinnerets, and in the possession of only two pairs of spinning glands, one pair to each pair of spinnerets, both of which are made up of the same kind of glands.

The only Theraphosids whose architecture has received much attention are the trap-door spiders; accordingly it may have some value to give a brief accout of the web and cocoon of *Evagrus*.

The web is always placed on the ground under large rocks, and generally in shady places where there is moisture. It seems that this species stays in colonies. Often a colony is found in one

place and fifteen feet away not a spider is to be found, from which we may conclude that the young do not scatter much. The web is a very primitive structure, containing no viscid threads and is hardly more than a thin irregular sheet woven on the ground and attached to twigs, leaves or the rock itself. There seems to be no definite form of nest but simply an irregular sheet of threads.

The cocoon of *Evagrus* is somewhat conical or cup-shaped as shown in Fig. 5, which figure also gives the relation of the



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size of spider to that of cocoon, being a sketch of a spider only a short time after she had finished her cocoon. The cocooning process was seen only once and that time the basal piece had been woven before direct observations began. The base, which was woven first, consists of the cup-shaped lower portion. A short time after it was finished, the spider was closely observed during the remainder of the process. At 2:55 P. M. May 4, the spider placed her epigynum across this base, and discharged from her genital aperture a large yellowish drop of viscid fluid, which remained attached to her for some time, while the ova were dropping into it. At 3:15 P. M. she freed herself from this drop and immediately began to spin the cover. She did this, in which process both pairs of spinnerets were used, by standing with her legs and palpi on the margin of the base, and sweeping her spinnerets from side to side over the egg-mass, never at any

time allowing her body to touch the cocoon. Occasionally, she would change her position or take short rests. At first the threads were loosely woven, but at the latter part of the process they were closely woven. The weaving of the cover lasted from 3:19 P. M. to 3:56 P. M. Then by raising her spinnerets and swinging them from side to side above the cover, she built a kind of outside cover or what seemed later to be a suspensor above the cocoon. This lasted until 4:12 P. M. when she began biting the old connection with the web, leaving it suspended at four corners and by means of the suspensor she had just made. At 5:30 she quit operations, and left the cocoon suspended. The finished cocoon is somewhat hemispherical beneath, the base, while the cover is a flat disc. From this observation, and from observing others kept in cages, and also those found in natural conditions, the cocoon seems to be spun upon a part of the web. In the natural conditions, it is suspended from the under side of the web at about the central portion.

Here, it is seen that the cocoon of *Evagrus* consists of two parts, the base and cover. This goes to uphold the observations of Montgomery (1903), as pointed out by him for several genera, that the cocoons of all spiders are made of two parts, the base and the cover.

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